

Smart Glove: Accelerometer and Flex Sensor enabled with GSM Technology

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Abstract- This paper includes the combination of several elements and aspects such as hardware, electronic and software. the steps to achieve the desired goal: fabricate the electronic part to glove which consist of flex sensors, accelerometer, microcontroller and LCD, To Design and modify the algorithm in C language programming using Arduino Software. Flex sensors sit on the fingers, monitoring how they're being manipulated, while an accelerometer integrated into the fabric of the glove figures out how the hand is being held and the direction in which it's pointing. Flex sensor plays the major role where the change in resistance depending on the amount of bend on the sensor combining with accelerometer measurement of the angle tilted by hand with respect to earth. Then, the data will be processed by microcontroller and equivalent text is seen on the LCD screen and corresponding speech is also obtained as output as per the requirement of the user. The developed project will potentially reduce the communication gap between mute and normal people.

Keywords- Accelerometer, Arduino, Flex Sensor, Gloves, GSM, LCD

I. INTRODUCTION

In our life we meet many disable people, some of them are partially and some are completely disabling. The partially impaired people like dumb, deaf, paralysis in one leg or hand manages their life with difficulties and feel separate from others. Here communication plays major role to feel someone better and indulging them in an activity where they may say themselves as independent person. By this thought the project Smart Hand Gloves for Disable People is developed so that disable person can live his life as he wants. In this project, Flex Sensor plays the major role. The glove is fitted with flex sensors along the length of each finger and the thumb. The flex sensors give output in the form of voltage variation that varies with degree of bend. This flex sensor output is given to the ADC channels of microcontroller. It processes the signals and perform analog to digital signal conversion. Further the processed data is sent in a wireless manner to the receiver section. In this section the gesture is recognized and the corresponding output is displayed on LCD and simultaneously a speech output is play backed through speaker. The portability of this project is a major advantage. Thus, with the

help of this project, the barrier faced by these people in communicating with the society can be reduced to a great extent.

Among various ideas, but we selected a project that will help a group of people who are unable to listen and speak like as common people. This project helps those peoples to easily communicate with the common people. This project is not only just a scientific approach, but also introduces a prototype that can be applied in reality. It is really so hard for normal people to understand what deaf and mute people want to say. Normal people do not understand what they are saying. For their deafness, they are almost ignored in our society. But we believe they can contribute to our society. We try to solve this problem for deaf and mute peoples. Our project is to convert finger movement into displaying letters and to store this conversion letters in a micro-controller-based system that converts movements of the fingers to alphabets and words are displayed on an LCD. It is a project which aims to bridge the gap between deaf and dumb community and normal masses. This project converts sign language to text and speech. Among various ideas, but we selected a project that will help a group of people who are unable to listen and speak like as common people. This project helps those peoples to easily communicate with the common people. This project is not only just a scientific approach, but also introduces a prototype that can be applied in reality. It is really so hard for normal people to understand what deaf and mute people want to say. Normal people do not understand what they are saying. For their deafness, they are almost ignored in our society. But we believe they can contribute to our society. We try to solve this problem for deaf and mute peoples. Our project is to convert finger movement into displaying letters and to store this conversion letters in a micro-controller-based system that converts movements of the fingers to alphabets and words are displayed on an LCD.

II. LITERATURE SURVEY

Mahesh Kumar N B, [1] Conversion of Sign Language into Text, Sign Language Recognition is one of the most growing fields of research area. Many new techniques have been developed recently in this area. The Sign Language is mainly used for communication of deaf-dumb people. This paper shows the sign language recognizing of 26 hand gestures in Indian sign language using MATLAB. The proposed system

contains four modules such as: pre-processing and hand segmentation, feature extraction, sign recognition and sign to text. By using image processing the segmentation can be done. Some of the features are extracted such as Eigen values and Eigen vectors which are used in recognition. The Linear Discriminant Analysis (LDA) algorithm was used for gesture recognition and recognized gesture is converted into text and voice format. The proposed system helps to dimensionality reduction

Albert Mayan J, Dr.B. Bharathi, [2] Smart Gloves for Hand Gesture Recognition Using Sign Language to Speech Conversion System, individuals with discourse impedence think that it's hard to impart in a general public where the vast majority of the general population don't comprehend gesture-based communication. The thought proposed in this paper is a keen glove which can change over communication via gestures to discourse yield. The glove is embedded with flex sensors and a mem sensor. A novel technique for State Estimation has been produced to track the movement of turn in three dimensional spaces. The model was tried for its achievability in changing Indian Sign Language to voice yield. Despite the fact that the glove is expected for communication through signing to discourse transformation. Artificial mouth is established for the dumb people to overcome the complexity. It works on motion sensor, where the sensor reacts for every action by the user. Database stores the messages and also all the templates. In the real time the template database is fed into a microcontroller and the motion sensor is fixed in their hand. For every action the motion sensors get accelerated and give the signal to the microcontroller.

Sonali N. Pawar, [3]Hand Glove to Translate Sign Language, this system describes talk able hand glove system which aims at translation of sign language to analyse text input and voice. This system consists of a talk able glove that can be worn by a deaf/dumb person to facilitate the communication in real-time with other people. The system translates the hand finger motion to corresponding letters using Contact switch sensors and an Arduino Board. Our main goal is to identify 26 alphabets and display text on the LCD. Once the text is obtained on the LCD then text to speech conversion operation is carried out and finally a voice output is obtained. Further, the text gain can also be viewed on a LCD or any portable hand held device. Our main aim is to set an interface between the Deaf or Dumb and normal people to improve the communication capabilities so that they can communicate handily with others. We mount contact switch sensor on the talk able hand glove and propose an efficient methodology to convert these sign languages with the help of Arduino UNO. This system will simplify the communication of deaf or dumb people with people able to normal communications without the need of a human translator

KanikaRastogi,[4]" A Review Paper on Smart Glove - Converts Gestures into Speech and Text, "generally people with hearing problem and speech disability use sign language based on hand gestures with specific motion to represent the language, they are communicating. Smart glove is an electronic device that translates sign language into text or speech in order to make the communication feasible between the mute communities with the general public. This glove translates the sign language gestures according to the American Sign Language Standard. This glove has been implemented with the help of flex sensors, accelerometer, microcontroller (Arduino Leonardo) and the Bluetooth chip. It Is a wireless data glove which is normal cloth driving glove fitted with flex sensors along the length of each finger.

Anju Varghese, Christy Paul, Dilna Titus, Amrutha Benny,[5] "Sign Speak Sign Language to Verbal Language" This projects aim is to find a solution for speech and hearing-impaired people generally speech and hearing-impaired people use sign language for communicating with others. Our project is to lower this barrier in their way of communication. Here we use a Wireless data glove which is a normal cloth glove fixed with flex sensors is used along the length of each finger and the thumb. Flex Sensor plays the major role, the working of flex sensors is based on their variation in resistance. Their resistance changes depending on the amount of flexion experienced by the sensor. By the use of suitable circuit, responses of the sensors are given to the raspberry pi, based on the responses from the sensors. Raspberry pi is a small microcomputer used for the working of the program in the hardware circuit which offers high reliability and fast response. Here the device recognizes the sign language Alphabets and Numbers. The main advantages of using this device are it recognizes words and sentences. It is in the process of developing a prototype to reduce the communication gap between differentiable and normal people. K.V.Fale,[6] "Smart Glove: Gesture Vocalizer for Deaf and Dumb People" Sign language is a natural way for communication between normal and dumb people, but often they find difficulty in communicating with normal people as we don't understand their sign language. Therefore, there always exists a language barrier. To minimize this barrier, we propose a device which can convert their hand gestures into voice which a normal person can understand. This device consists of a Wireless Glove, consisting of flex sensors and accelerometer. These sensors sense the movement of hands and fingers. This system consists of a speech synthesizer circuit which converts these movements of hand into real time speech output and a display will give the text for the corresponding gesture. The text and voice output being in English. So, this device provides efficient way of communication for both deaf-dumb and normal people.

P.B.Patel, SuchitaDhuppe,[7] "Smart Glove for Deaf and Dumb Patient" In this paper we represent smart glove for deaf

and dumb patient. About nine billion people in the world are deaf and dumb. The communication between a deaf normal visual people. This creates a very little room for them with communication being a fundamental aspect of human life. The blind people can talk freely by means of normal language whereas the deaf-dumb have their own manual-visual language known as sign language. Sign language is a non-verbal form of intercourse which is found amongst deaf communities in world. The languages do not have a common origin and hence difficult to interpret. The project aims to facilitate people by means of a glove-based communication interpreter system. The glove is internally equipped with five flex sensors. For each specific gesture, the flex sensor produces a proportional change in resistance. The processing of these hand gestures is in Arduino uno Board which is an advance version of the microcontroller and the LABVIEW software. It compares the input signal with predefined voltage levels stored in memory. According to that required sound is produced which is stored in memory with the help of speaker. In such a way it is easy for deaf and dumb to communicate with normal people.

Abdullah Al Mamun[8] "Flex Sensor Based Hand Glove for Deaf and Mute People" Sign language is the only way to communicate for listening and talking with disabled people. Approximately 10% of deaf people use sign language as their first language. We design a hand glove that will make the sign language understandable to all. An android mobile phone app is used to receive a voice which will convert it to speech and send it to the hand glove through wireless communication system. The result is shown on the LCD display of the glove. When the hand is moved, letter and word will be detected according to valid movement. As a consequence, the output will be displayed on mobile and LCD display.

DiponSengupta[8] "Smart Glove using Gesture Recognition Techniques for Speech Impaired and Deaf People" Speech impaired and deaf people in together have a population of 530 million across the globe. Hand gestures and facial expressions liaise between the dumb and the outside world. The main objective of the project is to help them discourse with other people. A smart glove once worn by a speech impaired will act as a translator which will convey his words in form of text and audio output. In this paper we focus mainly on the speech recognition techniques that can be inferred to improve the quality and accuracy of the smart glove. The system entirely comprises of the following modules: a smart glove with numerous sensors, data processing modules and a text to speech incorporated mobile application. The smart glove will be equipped with pressure sensors and flex-sensors in the finger joints. Kinect will be used for video spilling and recording the gestures other than the ones using the fingers. This project looks forward to interaction between computers and human which is a developing innovation.

KhushbooKashyap[9] "Digital Text And Speech Synthesizer Using Smart Glove For Deaf And Dumb" -Perhaps the single quality most central to humanness is the ability to exchange thoughts, ideas, and feelings with others. The importance of the capacity to connect with other people cannot be overstated. Helen Keller was once asked, if she could have eitherher vision or her hearing, but not both, which would she choose? Without hesitation, she replied, "My hearing." When asked why, she responded, "Blindness separates a person from things, but deafness separates him from people". Persons with severe and profound disabilities may be especially vulnerable to this problem of separation from the mainstream of society. Federal legislation has defined persons with severe disabilities as those "who because of the intensity of their physical, mental, or emotional problems, need highly specialized education, social, psychological, and medical services in order to maximize their full potential for useful and meaningful participation in society and for self-fulfillment. Many individuals who have severe disabilities experience substantial difficulties in communicating effectively with those around them.

Mina M. Abdel-Masieh [10] "Smart Communication System for Deaf- Dumb People" Communication is the best media used by the people to communicate with each other. Deaf-Dumb people find a difficulty in communicating with normal people and therefore they cannot be fully part and effective personnel in their societies. To overcome this problem a sign language interpreter system should be used for reducing the communication barrier between the deaf-dumb people and the normal ones. On the other Hand, almost all the currently used systems are based only on the American Sign Language and the English vocal language. Furthermore, all these systems have a very limited sign language database and so cannot be considered fully reliable. On the contrary, our proposed system deals with all these problems and has a very large database covering almost all the sign language database and supports the Arabic sign language and Arabic vocal language as well as efficient and friendly communication between deaf-dumb people and normal ones.

M.S.Kasar[11] "Smart Speaking Glove-Virtual tongue for Deaf and Dumb" : We develop a smart speaking glove for speechless patient & physically challenged people. Generally, speechless patient communicates through sign language which is not understood by normal human being. We have designed the project that overcome this problem & make the smooth communication of speechless patient with normal people. We use flex sensors which are fitted with glove to sense the finger movements. According to the finger movement microcontroller ATmega328 will display message on LCD. The text message is converted into voice using speak jet & this voice is heard via speaker.

Karibasappa R and Choodarathnakara A L[12] "Smart Glove Based Gesture Vocalizer for Deaf and Dumb" Sign language

is a natural way for communication between normal and dumb person, but often they find difficulty in communicating with normal people, as we don't understand their sign language. Therefore, there always exists a language barrier. To minimize this barrier, we propose a device which can convert their hand gestures into voice, which a normal person can understand. This device consists of a Wireless Glove, consisting of flex sensors and accelerometer. These sensors sense the movement of hands and fingers. This system consists of a speech synthesizer circuit, which convert these movements of hand gesture into real time speech output and the display will give the text for the corresponding gesture. The text and voice output being in any language, this device provides efficient way of communication for both deaf-dumb and normal people. AjitManware[13] "Smart Gloves As A Communication Tool For The Speech Impaired And Hearing Impaired" In order to share thoughts and to communicate with person with disability (dumb and deaf) the communication is the only medium so that they can convey the message to others. But there are lots of issues in communication with the person with disability. Therefore, a person with disability is not able to stand in the race with normal person. As we know that communication for a person who cannot hear is visual, not auditory. Usually dumb people use sign language for communication but they find difficulty in communicating with others who don't understand sign languages. So this creates barrier in the communication between these two communities. This paper aims to lower this barrier in communication with normal person. The main aim of the proposed system is to develop a cost-effective system which can give voice to voiceless person with the help of Smart Gloves. It means that using smart gloves communication will not be barrier between two different communities and they will be able to communicate easily with the normal person. Use of smart glove by person with disability makes nation grow and also, they will not differ themselves from the normal people.

Mohamed AkthamAhmed[14] "A Review on Systems-Based Sensory Gloves for Sign Language Recognition State of the Art between 2007 and 2017" Loss of the ability to speak or hear exerts psychological and social impacts on the affected persons due to the lack of proper communication. Multiple and systematic scholarly interventions that vary according to context have been implemented to overcome disability-related difficulties. Sign language recognition (SLR) systems based on sensory gloves are significant innovations that aim to procure data on the shape or movement of the human hand. Innovative technology for this matter is mainly restricted and dispersed. The available trends and gaps should be explored in this research approach to provide valuable insights into technological environments. Thus, a review is conducted to create a coherent taxonomy to describe the latest research divided into four main categories: development, framework, other hand gesture recognition, and reviews and surveys.

Then, we conduct analyses of the glove systems for SLR device characteristics, develop a roadmap for technology evolution, discuss its limitations, and provide valuable insights into technological environments. This will help researchers to understand the current options and gaps in this area, thus contributing to this line of research.

PallaviVerma [15] "Design of Communication Interpreter for Deaf and Dumb Person" In this paper, we describe gesture based device for deaf and dumb person as communication for a person, who cannot hear is visual, not auditory. Generally dumb people use sign language for communication, but they find difficulty in communicating with others who don't understand sign language. So, there is a barrier in communication between these two communities. This work aims to lower this barrier in communication. The main aim of the proposed project is to develop a cost-effective system which can give voice to voiceless people with the help of Smart Gloves. With the proposed work sign language is converted into text and speech using flex sensor and microcontroller. It means that using smart gloves communication will not be a barrier between two different communities.

III. PROPOSED METHODOLOGY

Block diagram of the system

The block contains the system;

- Arduino
- Flex sensor
- Accelerometer
- LCD display
- Voice module
- GSM module
- Panic button

Description of the Proposed System

The proposed model will be consisting of combination of hardware and software. Hardware part will include flex sensors, accelerometer, micro-controller, power supply, and android phone and GSM module(900a), LCD display and panic button. Software part will include programming section of arduinomicrocontroller. The hardware part includes flex sensor and accelerometer to take input from different gestures through gloves. Microcontroller is used to convert analog signal to digital signal, GSM Is Used to Sending the Messages to android phone.

Flex sensors sit on the fingers, monitoring how they're being manipulated, while an accelerometer integrated into the fabric of the glove figures out how the hand is being held and the direction in which it's pointing. Flex sensor plays the major role where the change in resistance depending on the amount of bend on the sensor combining with accelerometer measurement of the angle tilted by hand with respect to earth. Then, the data will be processed by microcontroller and equivalent text is seen on the LCD screen and corresponding

speech is also obtained as output as per the requirement of the user. The developed project will potentially reduce the communication gap between mute and normal people.

The working of the project starts from the movement of the hand glove where the flex sensor and accelerometer is attached, and these two sensors is connected to the analogs pins of the Arduino, when we bend the finger the value of the sensor is changes. The changing value of the sensor is depending upon the resistance and applied angle of the bending when we bend the sensor at some particular angle, we can see the value of the resistance is increase and accordingly the output gets reduced. If any problems will have the person switch on the button at that time sending message through GSM.

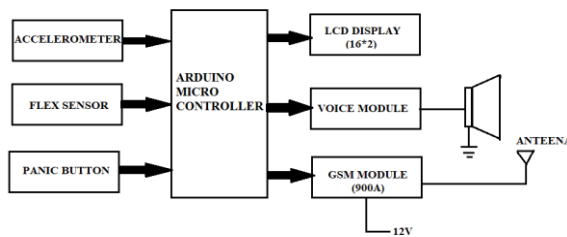


Fig.1: block diagram of the Smart Glove for Deaf and Dumb People

Arduino microcontroller

The Arduino Uno is a microcontroller board based on the ATmega328P microcontroller. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. Microcontroller is the heart of the device. It stores the required data and make use of it whenever the person uses the device. This device helps deaf and dumb person to announce their requirement. Arduino programs may be written in any programming language with a compiler that produces binary machine code

The Arduino project provides the Arduino integrated development environment (IDE), which is a cross-platform application written in the programming language Java. The Arduino IDE supports the languages C and C++ using special rules to organize code. All output signals generated from flex sensors are in analogue form and these signals need to be digitized. The microcontroller digitizes all analogue signals from the sensors for sensor signal selection. It supports both serial and parallel communication facilities.

Flex Sensors

Signed letters are determined using flex sensor on each finger. The flex sensors change their resistance based on the amount of bend in the sensor as shown in figure. As a variable printed resistor, the flex sensor achieves great form factor on a thin flexible substrate. When sensor placed in gloves is bent, it produces a resistance output correlated to the bend radius-the

smaller the radius, the higher the resistance value. They require a 5-volt input and output between 0 and 5V. The sensors are connected to the device via three pin connectors (ground, live, and output). In device, sensors are activated in sleep mode. It enables them to power down mode when not in use. By voltage divider rule, output voltage is determined and given by $V_{out} = V_{in} * R1 / (R1 + R2)$, where $R1$ is the other input resistor to the non-inverting terminal.

Accelerometer

An **accelerometer** is a device that measures proper acceleration.^[1] Proper acceleration, being the acceleration (or rate of change of velocity) of a body in its own instantaneous rest frame,^[2] is not the same as coordinate acceleration, being the acceleration in a fixed coordinate system. For example, an accelerometer at rest on the surface of the Earth will measure an acceleration due to Earth's gravity, straight upwards (by definition) of $g \approx 9.81 \text{ m/s}^2$. By contrast, accelerometers in free fall (falling toward the center of the Earth at a rate of about 9.81 m/s^2) will measure zero.

Accelerometers have multiple applications in industry and science. Highly sensitive accelerometers are components of inertial navigation systems for aircraft and missiles. Accelerometers are used to detect and monitor vibration in rotating machinery. Accelerometers are used in tablet computers and digital cameras so that images on screens are always displayed upright. Accelerometers are used in drones for flight stabilization. Coordinated accelerometers can be used to measure differences in proper acceleration, particularly gravity, over their separation in space; i.e., gradient of the gravitational field. This gravity gradiometry is useful because absolute gravity is a weak effect and depends on local density of the Earth which is quite variable.

GSM

GSM (Global System for Mobile communications) is a standard developed by the European Telecommunications Standards Institute (ETSI) to describe the protocols for second-generation (2G) digital cellular networks used by mobile devices such as mobile phones and tablets. It was first deployed in Finland in December 1991. As of 2014, it has become the global standard for mobile communications – with over 90% market share, operating in over 193 countries and territories.

2G networks developed as a replacement for first generation (1G) analog cellular networks, and the GSM standard originally described a digital, circuit-switched network optimized for full duplex voice telephony. This expanded over time to include data communications, first by circuit-switched transport, then by packet data transport via GPRS (General Packet Radio Services) and EDGE (Enhanced Data rates for GSM Evolution, or EGPRS). Subsequently, the 3GPP developed third-generation (3G) UMTS standards, followed by fourth-generation (4G) LTE Advanced standards, which do not form part of the ETSI GSM standard.

VOICE MODULE

This Voice Recognition Module is a compact and easy-control speaking recognition board. This product is a speaker-dependent voice recognition module. It supports up to 80 voice commands in all. Max 7 voice commands could work at the same time. Any sound could be trained as command. Users need to train the module first before let it recognizing any voice command. This board has 2 controlling ways: Serial Port (full function), General Input Pins (part of function). General Output Pins on the board could generate several kinds of waves while corresponding voice command was recognized.

IV. SIMULATION RESULTS

1. It is a social cause project
2. Deaf people can easily communicate with normal people
3. Easy to implement
4. Easy to make change of sensor windows according to wearing hand
5. Portable design works on 9V small Radio battery
6. Audio as well as Visual output



Fig.2: Smart Glove Prototype Picture

V. CONCLUSION

The main aim of the paper is to reduce the communication gap between deaf or mute community and normal people. This system is proposed to improve lifestyle of deaf and dumb people. This is also favorable for degrading the communication difference between the blind person and the dumb person. All over the paper is effective and efficient because it is using GSM.

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